Consider the reactions of the CNO bi-cycle. First, tabulate the relevent electron screening factors, nuclear cross-sections ($\langle\sigma v\rangle$) and characteristic species lifetimes. Then use these data to compute and plot how the (log) abundances of the CNO isotopes change with (log) time for a star with a central density of 100 g-cm^{-3} and a central temperature of 30 million degrees.

Non-Resonant Reactions

Reaction	$S(E=0)$ (keV-barns)	$\frac{dS}{dE}$ (barns)
$^{12}\mathrm{C}(p,\gamma)^{13}\mathrm{N}$	1.40	4.26×10^{-3}
$^{13}\mathrm{C}(p,\gamma)^{14}\mathrm{N}$	5.50	1.34×10^{-2}
$^{14}\mathrm{N}(p,\gamma)^{15}\mathrm{O}$	2.75	...
$^{15}\mathrm{N}(p,{}^{4}\mathrm{He})^{12}\mathrm{C}$	5.34×10^{4}	8.22×10^{2}
$^{15}\mathrm{N}(p,\gamma)^{16}\mathrm{O}$	2.74×10^{1}	1.86×10^{-1}
$^{16}\mathrm{O}(p,\gamma)^{17}\mathrm{F}$	1.03×10^{1}	-2.81×10^{-2}

Resonant Reaction

Reaction	E_r (keV)	$(\omega\gamma)_r$ (MeV)
$^{17}\mathrm{O}(p,{}^{4}\mathrm{He})^{14}\mathrm{N}$	65	4.74×10^{-14}

Beta-decays

Reaction	τ (seconds)
$^{13}\mathrm{N}(\beta^{+},\nu)^{13}\mathrm{C}$	870
$^{15}\mathrm{O}(\beta^{+},\nu)^{15}\mathrm{N}$	178
$^{17}\mathrm{F}(\beta^{+},\nu)^{17}\mathrm{O}$	95

Ratio of $^{15}\mathrm{N}(p,\gamma)^{16}\mathrm{O}$ to $^{15}\mathrm{N}(p,{}^{4}\mathrm{He})^{12}\mathrm{C} = 4\times10^{-4}$.

Initial Stellar Mass Fractions

$\mathrm{H}=0.75$	$\mathrm{He}=0.23$	$^{12}\mathrm{C}=3.91\times10^{-3}$	$^{14}\mathrm{N}=1.25\times10^{-3}$	$^{16}\mathrm{O}=1.48\times10^{-2}$
		$^{13}\mathrm{C}=4.75\times10^{-5}$	$^{15}\mathrm{N}=4.94\times10^{-6}$	$^{17}\mathrm{O}=5.91\times10^{-6}$

All other abundaces are zero.